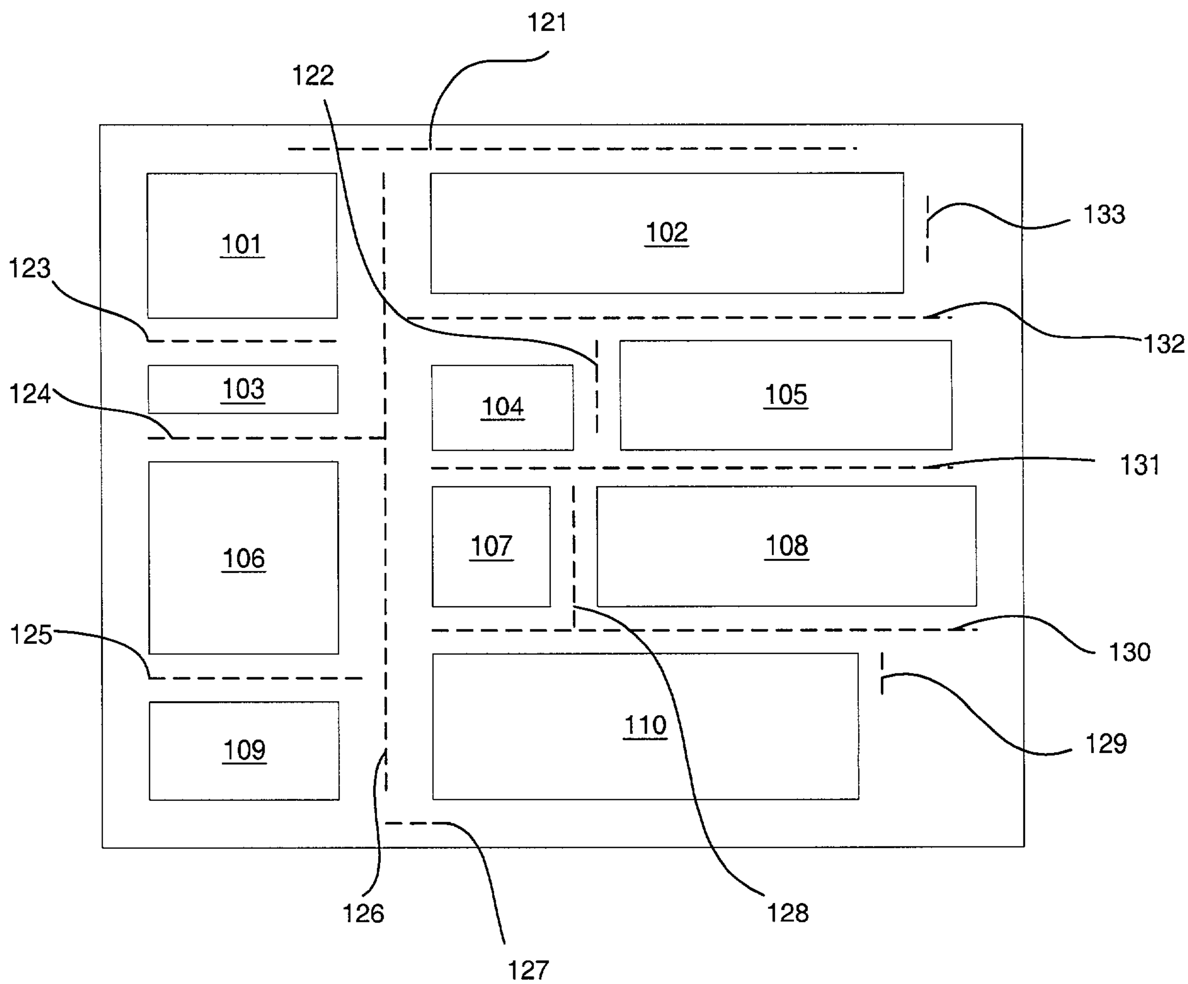
ET 150396321 US



(Prior Art)

Figure 1

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Figure 2

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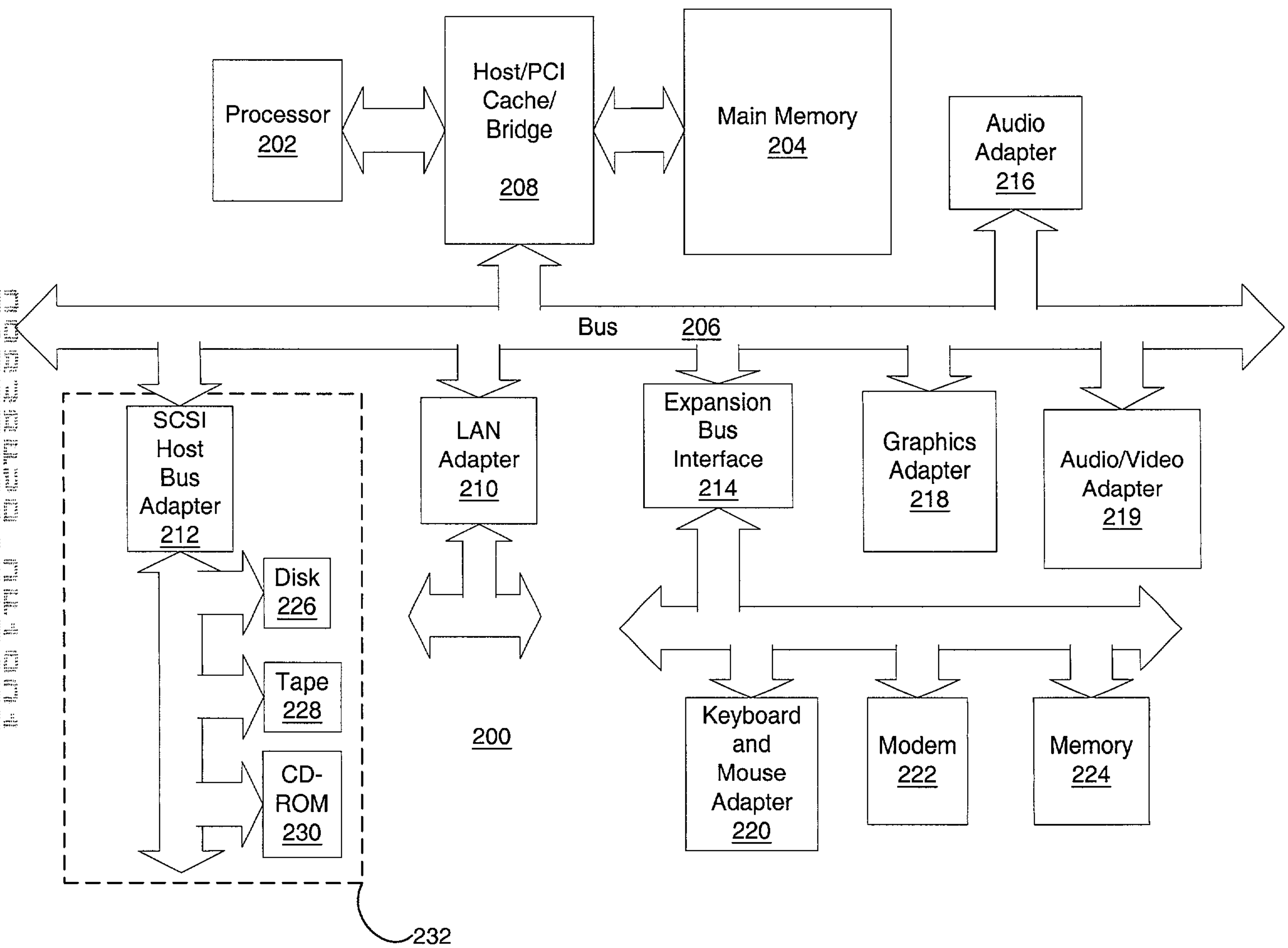

Figure 3

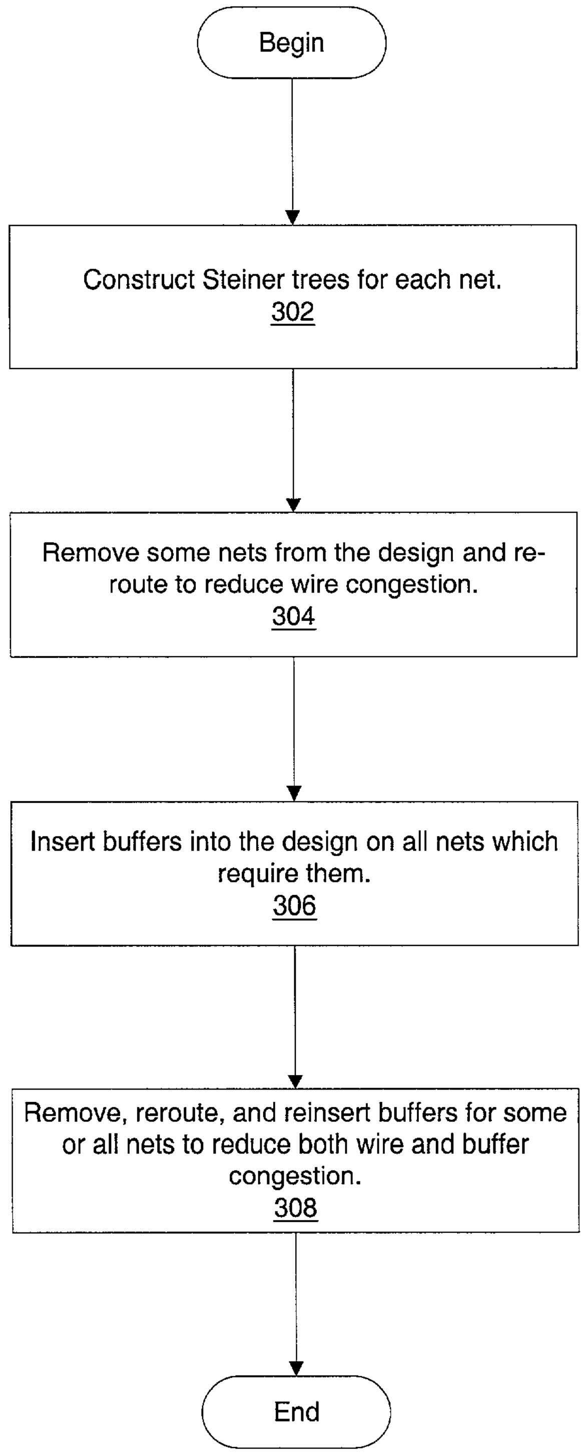
Begin
Construct Steiner trees for each net.
302
Remove some nets from the design and re-route to reduce wire congestion.
304
Insert buffers into the design on all nets which require them.
306
Remove, reroute, and reinsert buffers for some or all nets to reduce both wire and buffer congestion.
308
End

Figure 4A

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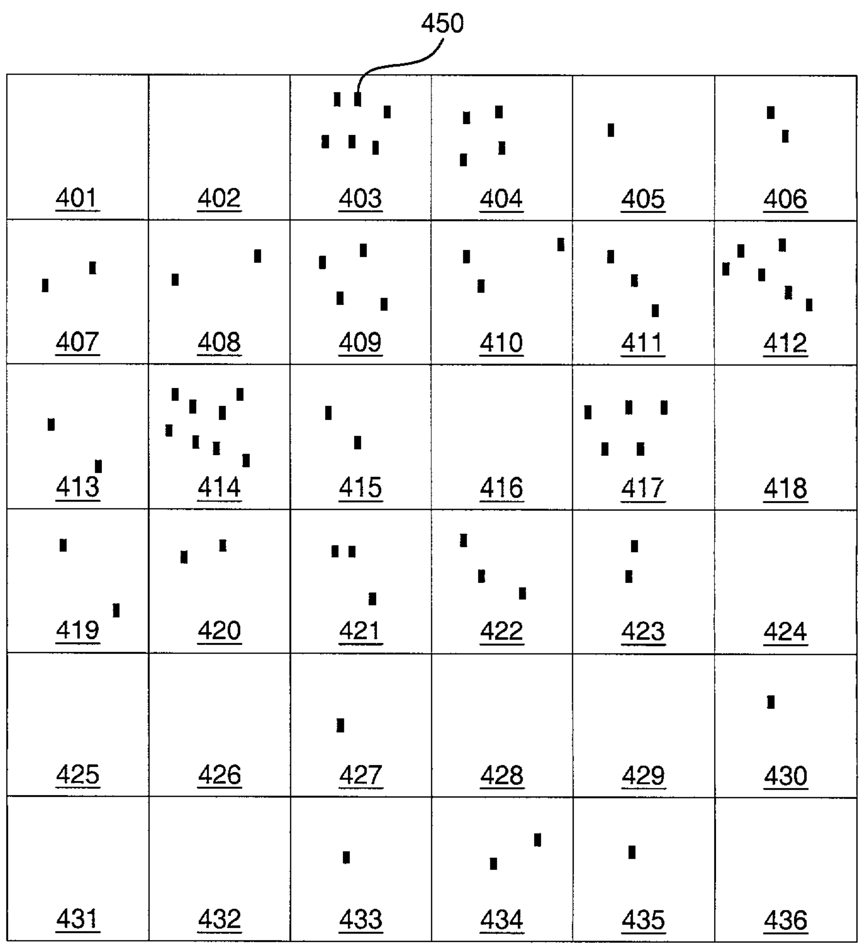

Figure 4B

0 401	0 402	6 403	4 404	1 405	2 406
2 407	2 408	4 409	3 410	3 411	6 412
2 413	8 414	2 415	0 416	5 417	0 418
2 419	2 420	3 421	3 422	2 423	0 424
0 425	0 426	1 427	0 428	0 429	1 430
0 431	0 432	1 433	2 434	1 435	0 436

Figure 5

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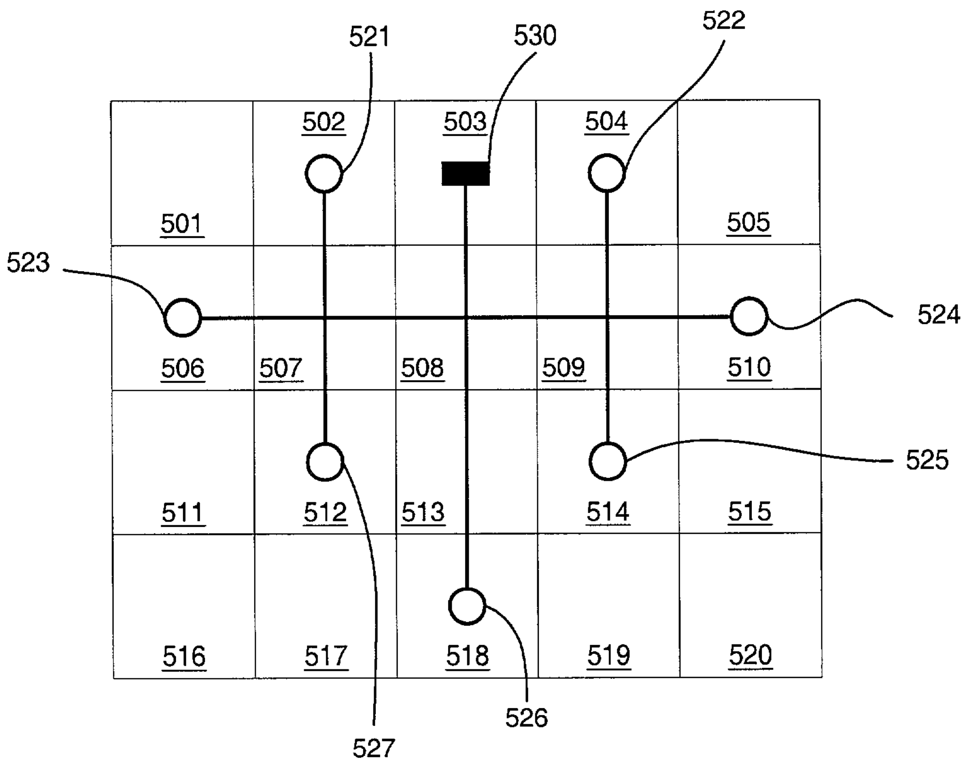

Figure 6

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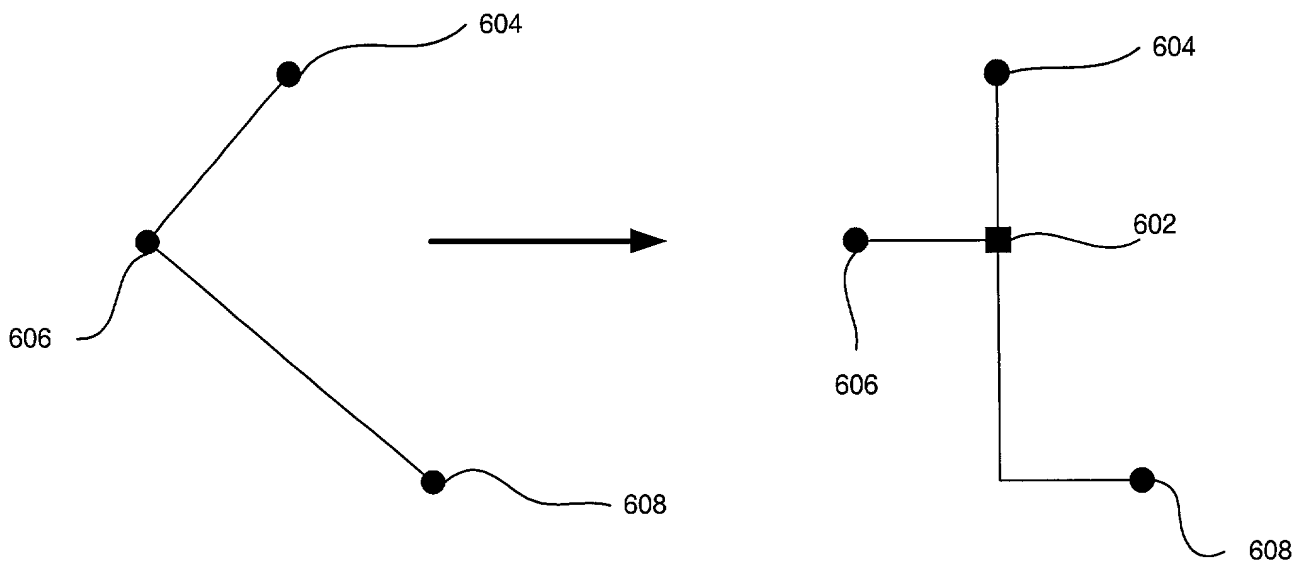
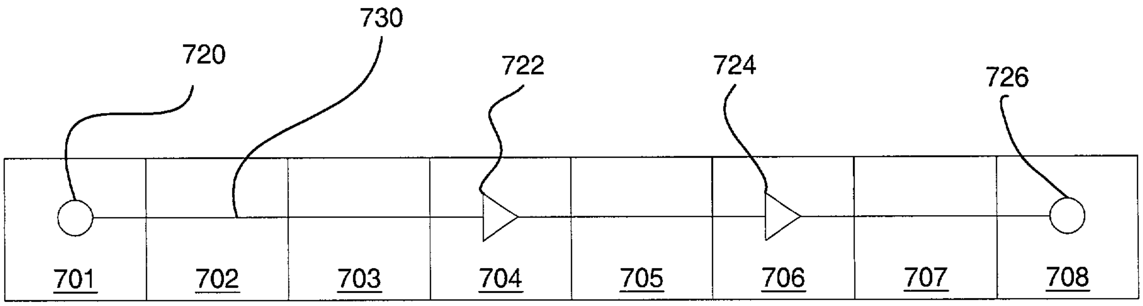


Figure 7



B(v)	8	5	12	3	5	0
b(v)	3	4	2	3	0	0
p(b)	2.5	3.6	2	0.8	4	5
q(v)	1.3	8.6	0.5	∞	1.0	∞

Figure 8

1. Set $C_t[j] = 0$ for $1 \leq j < L_i$ and sink t. Set $v = t$

2. while $v \neq s$ do

    for $j = 1$ to $L_i - 1$ do

        Set $C_{par(v)}[j] = C_v[j-1]$

    Set $C_{par(v)}[0] = q(par(v)) + min\{C_v[j] \| 0 \leq j < L_i\}$

    Set $v = par(v)$.

3. Let v be such that $par(v) = s$. Return $min\{C_v[j] \| 0 \leq j < L_i\}$.

Figure 9

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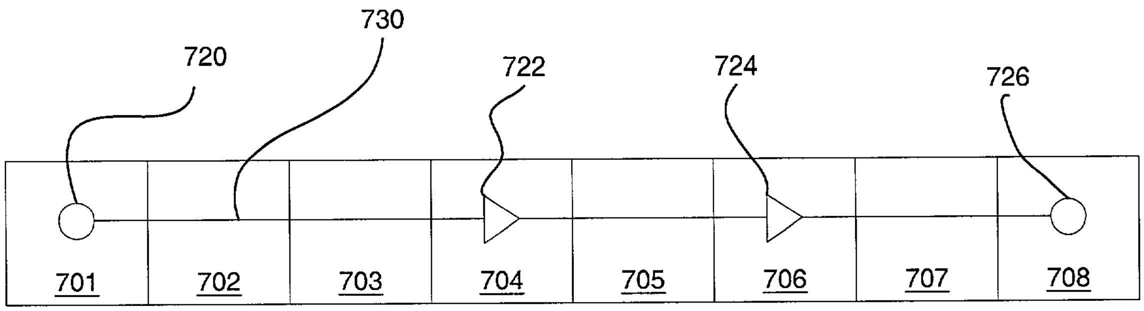
and Wire Resource Allocation



q(v)	1.3	8.6	0.5	∞	1.0	∞	
$C_v[0]$	2.8	9.6	1.5	∞	1.0	∞	0
$C_v[1]$	9.6	1.5	∞	1.0	∞	0	0
$C_v[2]$	1.5	∞	1.0	∞	0	0	0

900 920 921 922 923 924 925

Figure 10A

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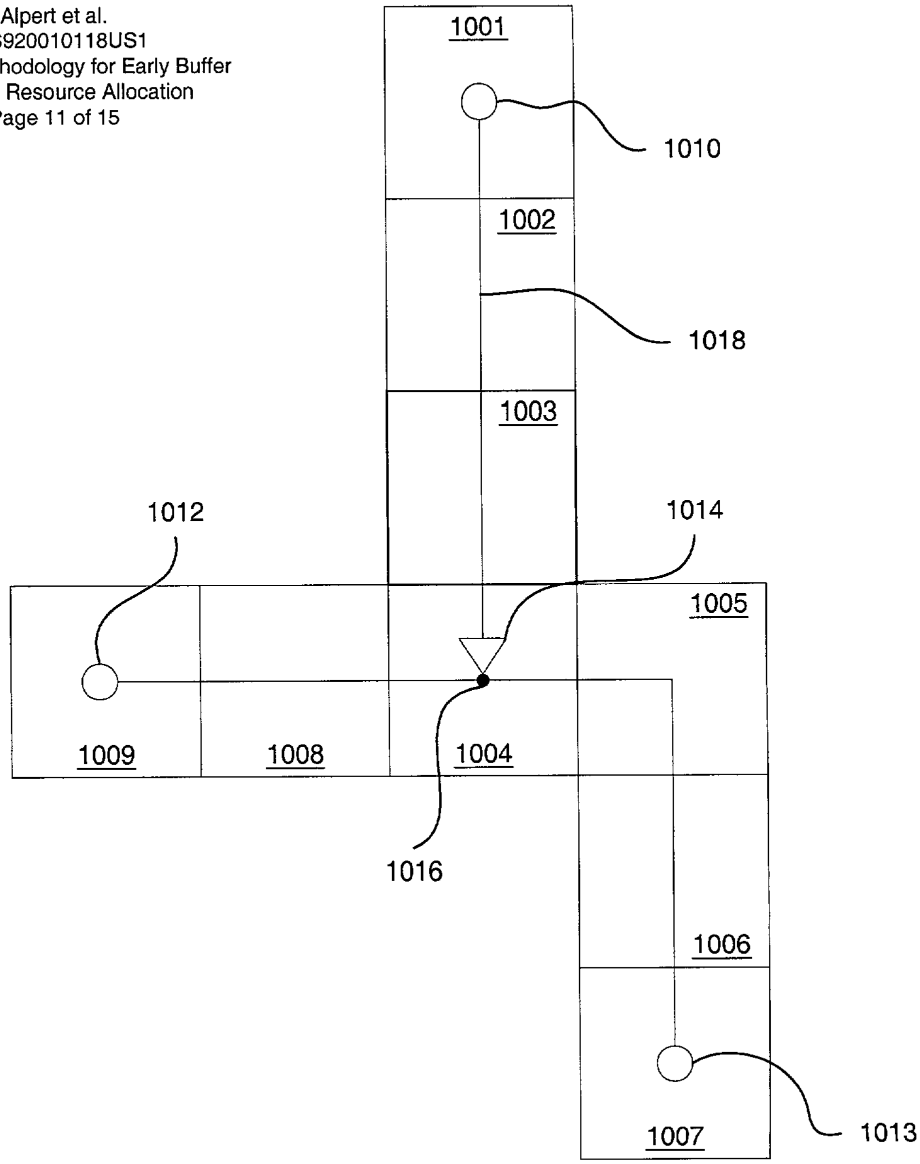

Figure 10B

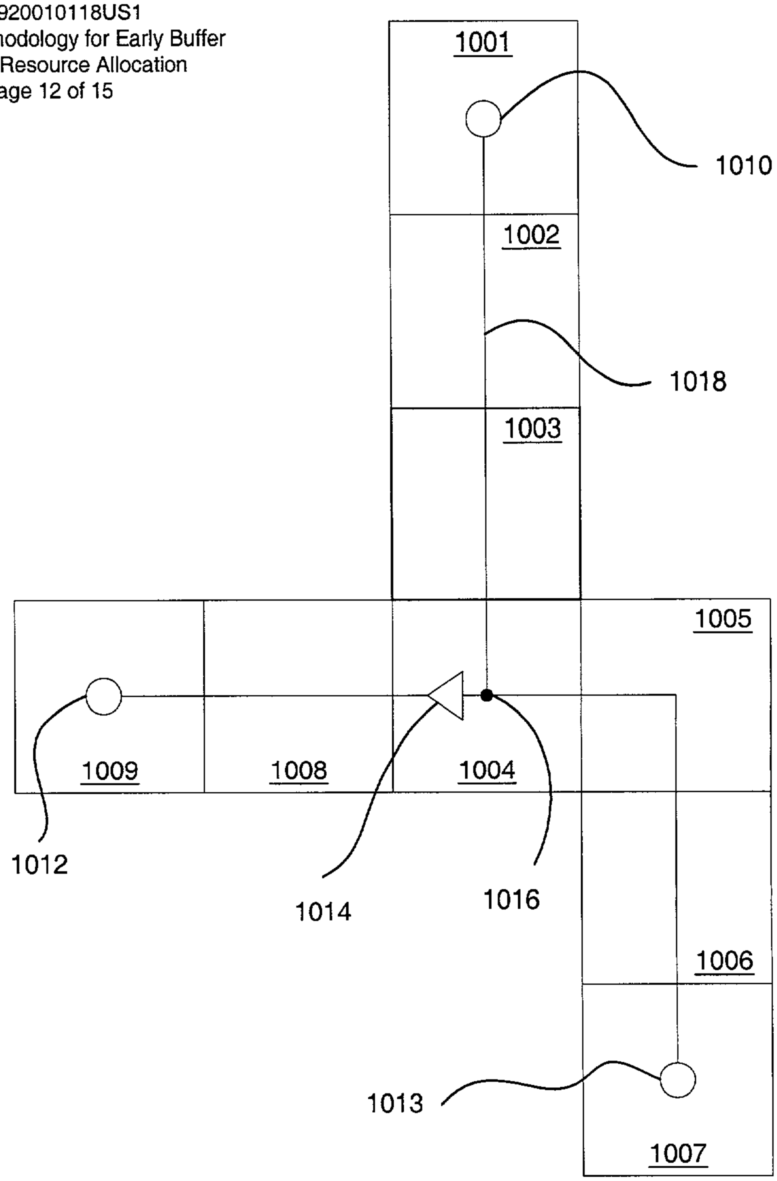
1001
1010
1002
1018
1003
1005
1009
1008
1004
1012
1014
1016
1006
1013
1007

Figure 10C

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and Wire Resource Allocation

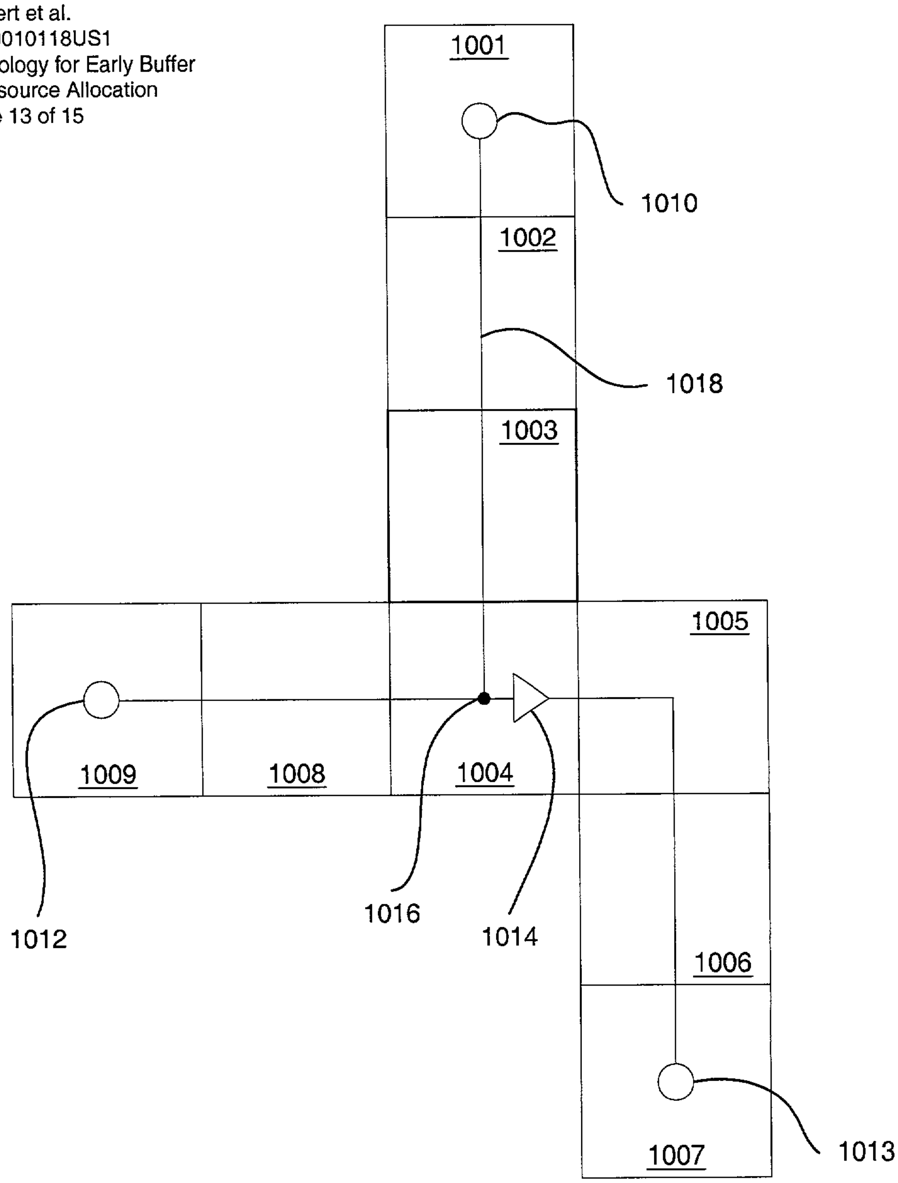

Figure 11

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Practical Methodology for Early Buffer and Wire Resource Allocation

1. Pick an unvisited node v such that all descendants of v have been visited.

   While $v \neq s$ do

2. if v is a sink then
   Set $C_v[j] = 0$ for $1 \leq j < L_i$.

3. if v has one child $l(v)$ then
   for $j = 1$ to $L_i - 1$ do
   Set $C_v[j] = C_{l(v)}[j-1]$
   Set $C_v[0] = q(v) + min\{C_{l(v)}[j] \| 0 \leq j < L_i\}$

4. if v has two children $l(v)$ and $r(v)$ then

4.1 for $j = 2$ to $L_i - 1$ do
   Set $C_v[j] = min\{C_{l(v)}[j_l] + C_{r(v)}[j_r] \| j_l + j_r + 2 = j\}$

4.2 Set $C_v[0] = q(v) + min\{ C_{l(v)}[j_l] + C_{r(v)}[j_r] \| j_l + j_r + 2 \leq L_i\}$

4.3 Set $C_v[1] = \infty$

4.4 for $j = 1$ to $L_i - 1$ do
   Set $C_v[j] = min\{C_v[j], q(v) + C_{l(v)}[j-1], q(v) + C_{r(v)}[j-1]\}$

5. mark v as visited
   pick an unvisited node v such that all descendants of v have been visited.

6. Return $min\{C_s[j] \| 0 \leq j < L_i\}$.

1100

Figure 12

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